CHAPTER 2. IMPACTS AND THREATS TO NEARSHORE HABITAT

Summary

A variety of activities affect the diverse habitats of Puget Sound's nearshore areas. This chapter discusses threats associated with development and issues of managing these threats. Information from interviews with shoreline planners, scientists and regulators demonstrates that even permitted activities are causing a loss of nearshore habitat. Other reports suggest that some of these losses are permanent and that the regulatory system does not adequately protect nearshore habitats in Puget Sound. Interviews and limited data gathered from tracking permits show that development activities and threats vary regionally. State and local governments need to manage the environment in a way that recognizes these differences, but allows the ecosystem to be viewed holistically.

Shoreline planners, habitat biologists and scientists from around Puget Sound identified various impacts and threats to the nearshore. Concern was expressed about activities that directly alter the environment and about development activities occurring further inland, which indirectly but significantly affect the nearshore area.

The level of concern for certain activities varied considerably among jurisdictions depending on:

1) The present condition of the shoreline (how much is already altered, how valuable is the existing habitat).
2) The degree to which the shoreline manager understands the connections between development activities along the shoreline and impacts to nearshore habitat.
3) The level of current development activities (number and type of permit proposals).
4) The degree of protection offered by the local shoreline master program.
5) Personal concerns for economic growth and private property rights.
6) Natural geological conditions.

Regional differences

Northern Puget Sound

In northern Puget Sound (San Juan, Whatcom, Skagit, and Island counties) activities related to tourism and large developments in non-urban, sensitive nearshore areas are of greatest concern to local resource managers. Shoreline armoring — installing a hard structure such as a bulkhead to protect shoreline property from erosion or other damage— is less of a concern in the San Juan islands because of the area's rocky shoreline. The issues of concern in the northern region include marinas and docks, anchoring boats, degraded water quality, and the direct physical alteration of important habitats, such as herring spawning grounds, caused by large developments in non-urban areas.

Central Puget Sound

Central Puget Sound (King, Pierce, Kitsap and Snohomish counties) faces many issues along its shorelines. The shoreline area of King County and much of Snohomish County is already heavily urbanized. Most of the shoreline in these two counties has been altered by

the railroad construction along the shore. Kitsap County is growing rapidly along its shoreline. A tremendous number of property owners apply for permits to armor their shoreline each year in Kitsap County. Pierce County's main concern is the number of docks being built along its shores.

Southern Puget Sound

In southern Puget Sound (Thurston and Mason counties) concerns are focused on the impact of shoreline armoring and the cumulative impacts of residential development. This region has a great deal of low- and no-bank shoreline, allowing greater access to the beach and a prevalence of shoreline armoring projects. Thurston and Mason counties also have an abundance of aqua-culture.

Western Puget Sound

Virtually no shoreline armoring or dock construction occurs in Clallam County. Jefferson County receives a small number of requests for shoreline armoring, but of greater concern is the number of mooring buoys being installed around the county.

Activities and Their Impacts on Nearshore Areas

This section summarizes the major activities that threaten nearshore habitat and explains potential effects that are known or suspected. Table 1 lists threats identified in the interviews and the potential impact of each activity on nearshore habitat.

Residential development

Major urban waterbodies ñ focal points for commercial and industrial development ñ account for less than 10 percent of the Puget Sound shoreline (Shipman, 1997), leaving approximately 90 percent of the shoreline available for residential development. The extent to which residential development affects nearshore habitat depends on many factors, including geology of the shoreline, the size of each development, materials used, construction practices, timing and setbacks. The most significant impacts result from the dwelling itself, the landscaping and added amenities. Activities that can affect nearshore habitat include clearing native vegetation along the shoreline, adding impervious surfaces (such as a roof, driveway or lawn) that increase stormwater runoff, introducing contaminants (chemicals and fertilizers used for lawn maintenance and fecal bacteria from on-site sewage systems), and directly disturbing or altering the shoreline by constructing stairways, bulkheads, docks and piers. The impacts of these activities to the nearshore include loss of shoreline habitat, destabilization of bluffs, interference with natural erosion processes, increased erosion and contamination of the nearshore.

Table 1. Summary of issues of concern and known or possible impacts

Issue of Concern	Known or Possible Impacts
aquaculture	possible effects of tube worms, effects of fecal matter generated, elimination of biodiversity, accidental release of non-native species, destruction of eelgrass
beach clean up after slides	beaches need the influx of new materials[1]
bulkheads / armoring	interference with natural erosion and groundwater, scouring of beach[1], change in biological populations[3], removal of overhanging and shoreline vegetation
docks and piers	shading of eelgrass[2], interference with fish migration[3]
dredging	loss of shallow water habitat
failing septic systems	fecal coliform contamination
ferries	the four major categories of impacts listed below[1,2,3,4]
filling	loss of shallow water habitat
hydrologic changes / diversions to freshwater	change in sediment deposition, loss of estuarine habitat
large projects in sensitive areas	inability to mitigate for some habitats
lawns	runoff of pollutants[4], loss of native vegetation, addition of water (sprinkler systems)[1]
log rafting	physical scouring of intertidal and subtidal, accumula tion of wood waste
long-term moorage / liveaboards (outside of marinas)	discharge of waste (gray water and sewage), water qual ity impacts[4]
marinas	structural impacts as well as associated impacts (e.g. due to increased boat traffic); water quality impacts[4]
mooring buoys	scouring of eelgrass[2]
recreational boating	pollution from waste[4], increased need for moorage and anchorage opportunities
residential development	erosion effects, all major categories of concern[1,2,3,4]
reverse osmosis	may cause salinity changes
seaweed harvest	over-harvest, loss of habitat
sediment remediation	disposal occurs in the nearshore
Spartina anglica	elimination of native shoreline habitats
stairways	additional clearing of vegetation[1]
stormwater	increased bluff erosion[1], pollution[3]
tourism	overuse of public areas, trampling of vegetation
upland runoff	eutrophication, turbidity, choking out eelgrass[2], limiting eelgrass growth
vegetation removal & over-clearing of land	unstable bluffs[1], loss of native vegetation, loss of biodiversity

Footnotes—Major Categories of Concern for Impacts:
1 interruptions and exacerbation of shoreline erosion processes
2 impacts to eelgrass (suppressing growth or physical scouring)
3 interruptions to fish migration and fish spawning (particularly baitfish)
4 water quality degradation (contamination of resources and changes to resource populations)

Shoreline Armoring

Many people build artificial structures, such as bulkheads and seawalls, on their shoreline property. Referred to as shoreline armoring, this very common practice is a primary concern of state and some local regulators. While most shoreline managers consider shoreline armoring on residential property a serious problem, many property owners view bulkheads as a necessary addition to waterfront homes to control erosion, maintain real estate values and provide a tidy landscaping feature for the front of their home. Shoreline armoring also occurs with commercial and industrial development projects, although it requires a different permitting process.

Shoreline armoring causes problems for nearshore habitats because it interferes with the coastal erosion process and requires clearing of natural vegetation. Concerns also focus on the permanence of the damage, the cumulative effects of armoring within a given geographic area, and long-term effects on species that depend on the intertidal zone for portions of their life-cycle. The natural process of bluff erosion is critical to maintaining a supply of sediment to the beach. Constructing a bulkhead at the bottom of a feeder bluff cuts off the supply of new sediments and the continuing wave action and littoral drift can result in localized beach loss and eventually accelerated, localized retreat of the bluff (Macdonald, 1995). Further information on the relationship of armoring to coastal erosion can be found in the Coastal Erosion Management Studies (Ecology, 1993-1997).

Those interviewed have witnessed changes to the intertidal shoreline caused by armoring and studies have documented changes to the beach substrate (Macdonald, 1995; Schreffler et al., 1995). In some places, the hard surface of the armoring structures increased wave energy, allowing both fine and coarse sediments to move out of the area due to littoral drift (Figure 1). This change in the natural shoreline process can cause problems, such as scouring of the beach. Such changes in beach sub-strate significantly impact some species of baitfish that use the intertidal area for spawning. These species include surf smelt, sand lance and rock sole. These baitfish form the base of the food chain for larger fish, marine birds and marine mammals. As activities cause losses of nearshore habitat, changes in other species of marine animals in Puget Sound can be expected.

The connection between habitat alteration and the spawning of surf smelt, sand lance and rock sole concerns habitat biologists. Beach surveys conducted in 1995 showed that baitfish depend on this type of habitat more than previously known (Pentilla, 1995). Thirty-four percent of all beaches surveyed yielded eggs of at least one species of the three baitfish species found in the intertidal beach. The reproduction of surf smelt, sand lance and rock sole is an integral and important part of Puget Sound beaches which resource managers should give the same consideration as more visible intertidal marine life (Pentilla, 1995).

Using a 1995 survey of 325 randomly selected shoreline sites in Puget Sound, scientists at the Department of Natural Resources estimated that one-third of Puget Sound's shoreline—approximately 800 miles—has been modified by human development (Figure 2). Twenty-five percent of the modifications have occurred in the intertidal zone—areas that are regularly covered by tides. Another eight percent of the modifications have occurred above the normal extent of tides. Impacts from modifications above the normal tidal range on the character and processes of shorelines characteristically are less severe than modifications in the intertidal zone. They can, however, adversely affect sediment supply needed to maintain existing beach habitat.

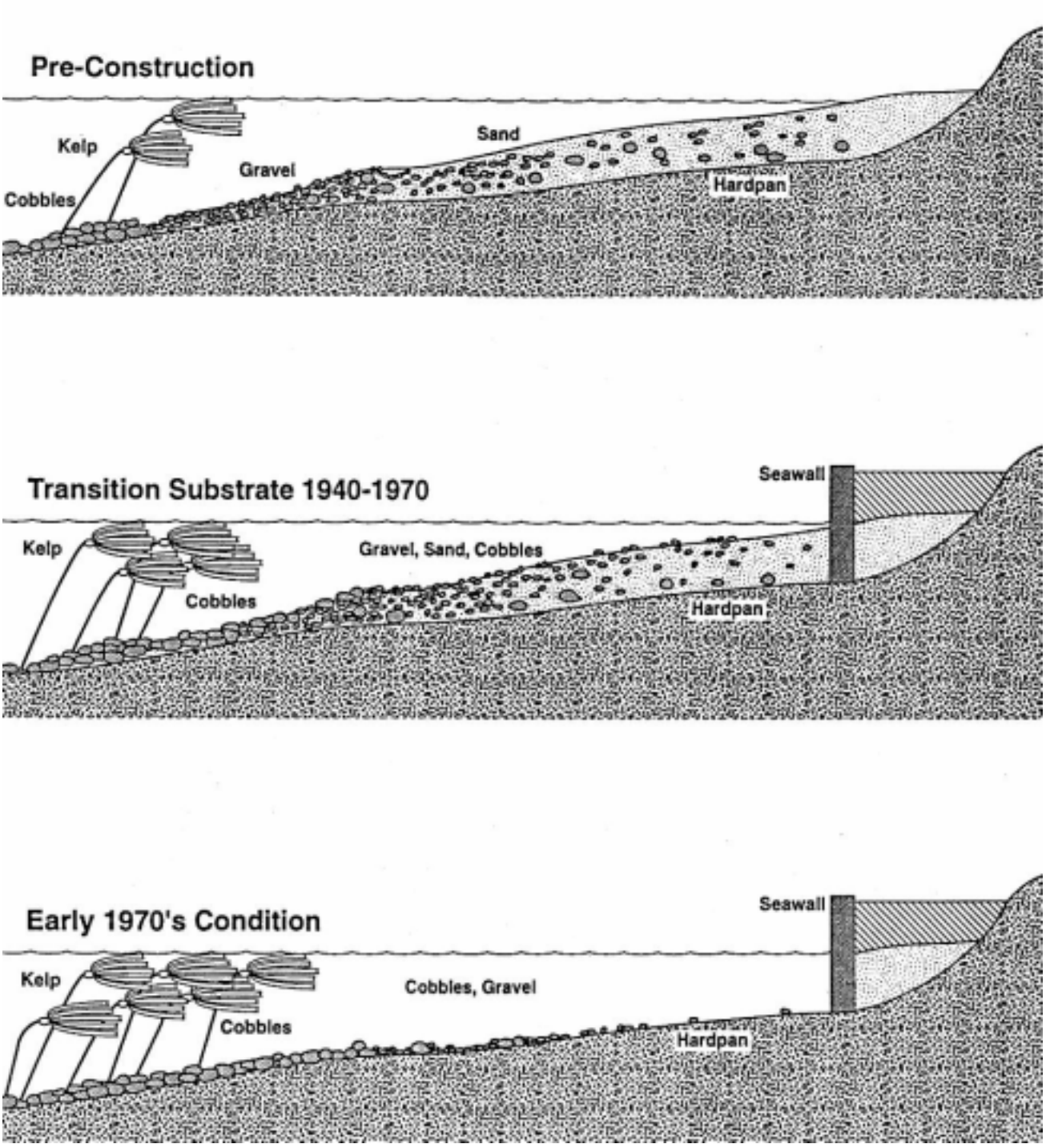

Figure 1. Progression of habitats at Lincoln Park Beach, Seattle 1917-1970 (Thom, Shreffler, and Macdonald, 1994).

The distribution of modified shorelines reflects historical development patterns and environmental factors in the Puget Sound basin. Central Puget Sound, with the basin's highest past and present population, has the highest level of shoreline modification overall (52 percent) and the highest percentage of shoreline with intertidal modification (45 percent). The areas of Whidbey Island, Hood Canal and south Puget Sound each have roughly one-third of their shorelines modified. The most striking difference among these regions is that southern Puget Sound has many more alterations in the intertidal zone, reflecting the low-bank environments in the region and the long history of aquaculture and settlement along the water. Morrison et al. (1993) found that the length of Thurston County's shoreline covered by armoring structures increased by more than 100 percent from 1977 to 1993.

The San Juan islands, the Strait of Juan de Fuca to Port Angeles, and the regions north of Guemes Channel (north of Camano Island) have the highest proportion of natural (unmodified) shoreline, almost 80 percent. Within this area, most modifications tend to be along the Strait of Juan de Fuca and the northern Olympic Peninsula. The northern part of the Sound has relatively more bedrock shorelines, which are less likely to erode (a primary reason that land-owners modify their shorelines).

A Hydraulic Project Approval (HPA) permit from the state Department of Fish and Wildlife is required for construction and other work that uses, diverts, obstructs or changes the natural flow or bed of fresh or salt waters in Washington (see Appendix A.) Information was requested from the database on four different types of HPA permits for the years 1990 to 1996. For purposes of managing watersheds, the state is divided into water resource Inventory areas (WRIAs). In the Puget Sound region, there are 19 WRIAs (Figure 3). Information in the database is categorized by WRIA. The data (Table 2, Figures 4-7) show the number of marine HPA permits granted by WRIA for the following activities: bank protection (diking, riprap and flood control), bulkhead construction (new and repair), docks, piers, wharves and breakwaters, and storm drains and sewer outfalls. The extent of the shoreline for each WRIA varies considerably, making comparisons difficult. For example WRIA 2 includes all the shoreline of San Juan county, while WRIA 10 covers just a small section of shoreline near Tacoma.

The data give some perspective of geographic differences in number and type of permits processed and what has happened from 1990 to 1996, but do not illustrate historical development activities. In areas where shorelines already are heavily armored, such as the west shore of Hood Canal, shoreline development activities from 1990-1996 appear to be minimal. (HPA data are reported to be unreliable prior to 1990 (Rings, 1997)). Figures 4 through 7 have been normalized for better comparison (number of permits divided by miles of shoreline) by showing the number of permits for each mile of shoreline.

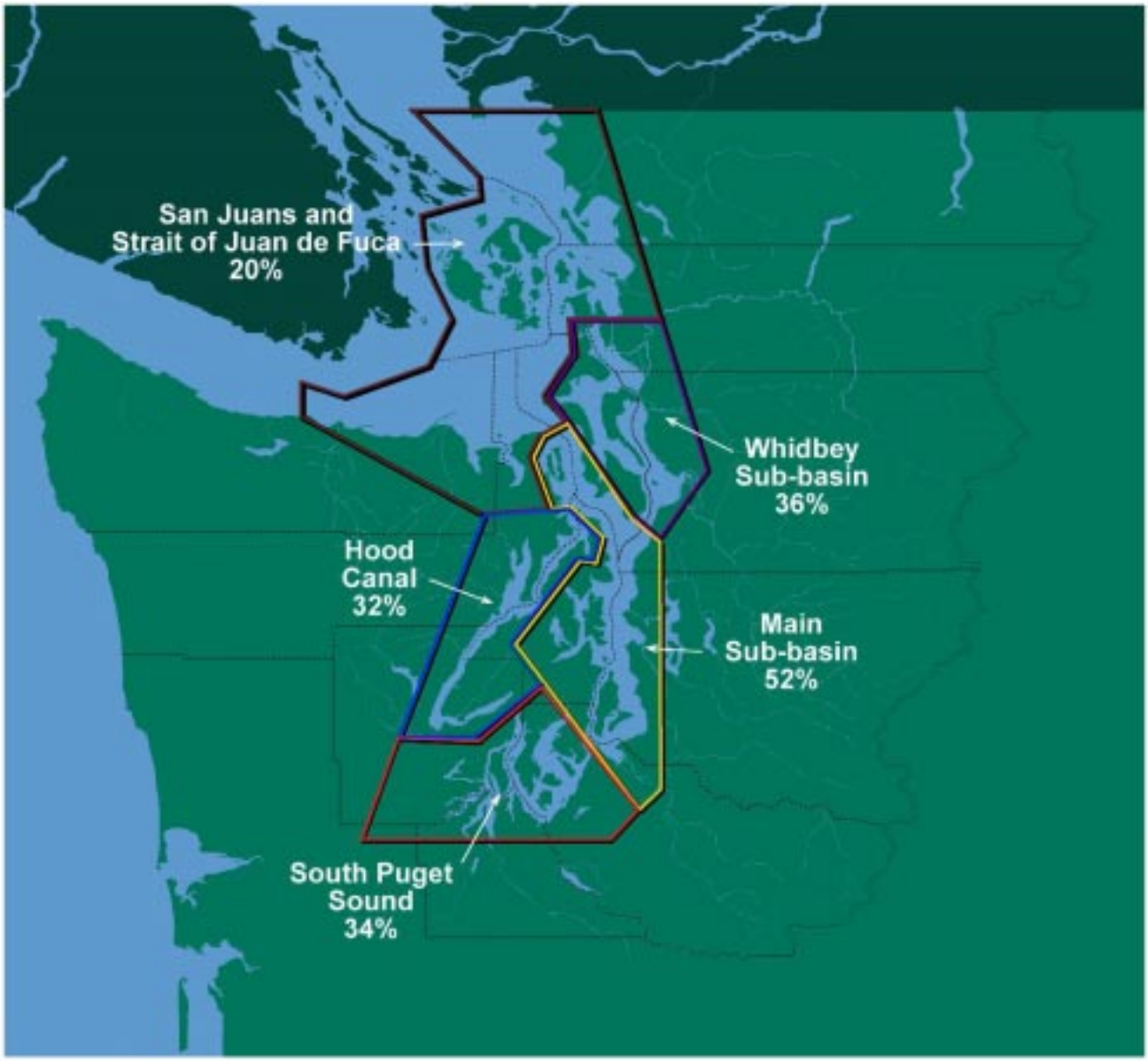

Figure 2. Percentage of Puget Sound shoreline that has been modified (Berry, 1997).

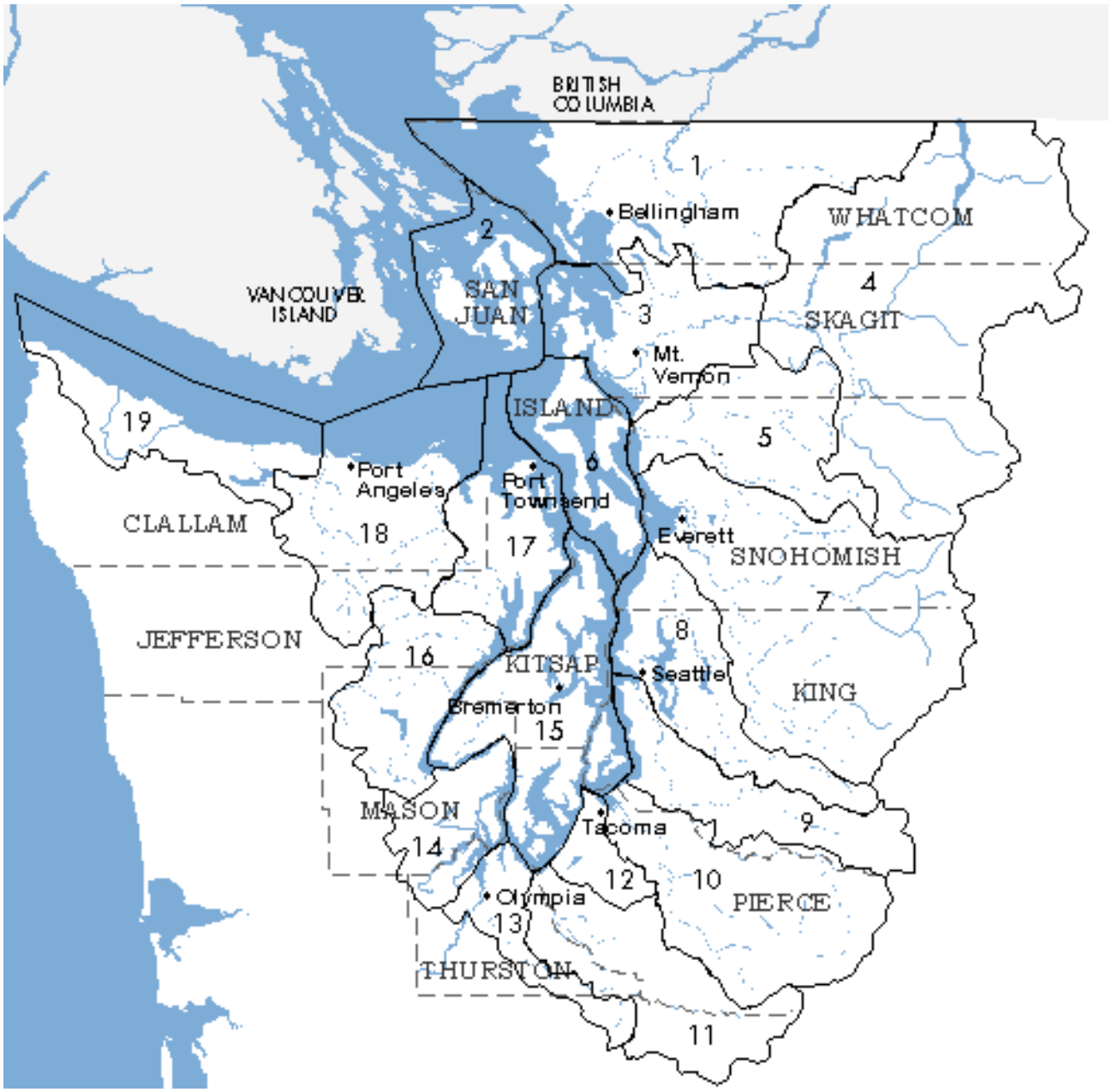

Figure 3. Water Resource Inventory Areas (WRIAs) in Puget Sound Basin.

Table 2. Numbers of Four Types of Marine Hydraulic Project Approval Permits by WRIA for the years 1990 through 1996

WRIA	WRIA Name	Shoreline Miles	Bank Protection	New & Repaired Bulkhead	Dock, Pier	Storm Drains
1	Nooksack	149	8	25	37	7
2	San Juan	410	4	20	158	8
3	Lower Skagit	209	25	44	44	12
5	Stillaguamish	22	0	2	0	0
6	Island	208	5	241	61	27
7	Snohomish	48	10	44	15	8
8	Cedar-Sammamish	137	5	5	23	5
9	Duwamish-Green	49	13	34	25	9
10	Puyallup-White	36	3	16	22	10
11	Nisqually	11	0	0	1	0
12	Chambers-Clover	25	1	2	15	1
13	Deschutes	77	3	115	22	1
14	Kennedy-Goldsborough	186	24	248	88	1
15	Kitsap	519	48	574	295	60
16	Skokomish-Dosewallips	49	5	21	15	1
17	Quilcene-Snow	202	25	50	38	12
18	Elwah-Dungeness	55	0	7	11	3
19	Lyre-Hoko	85	4	0	11	1

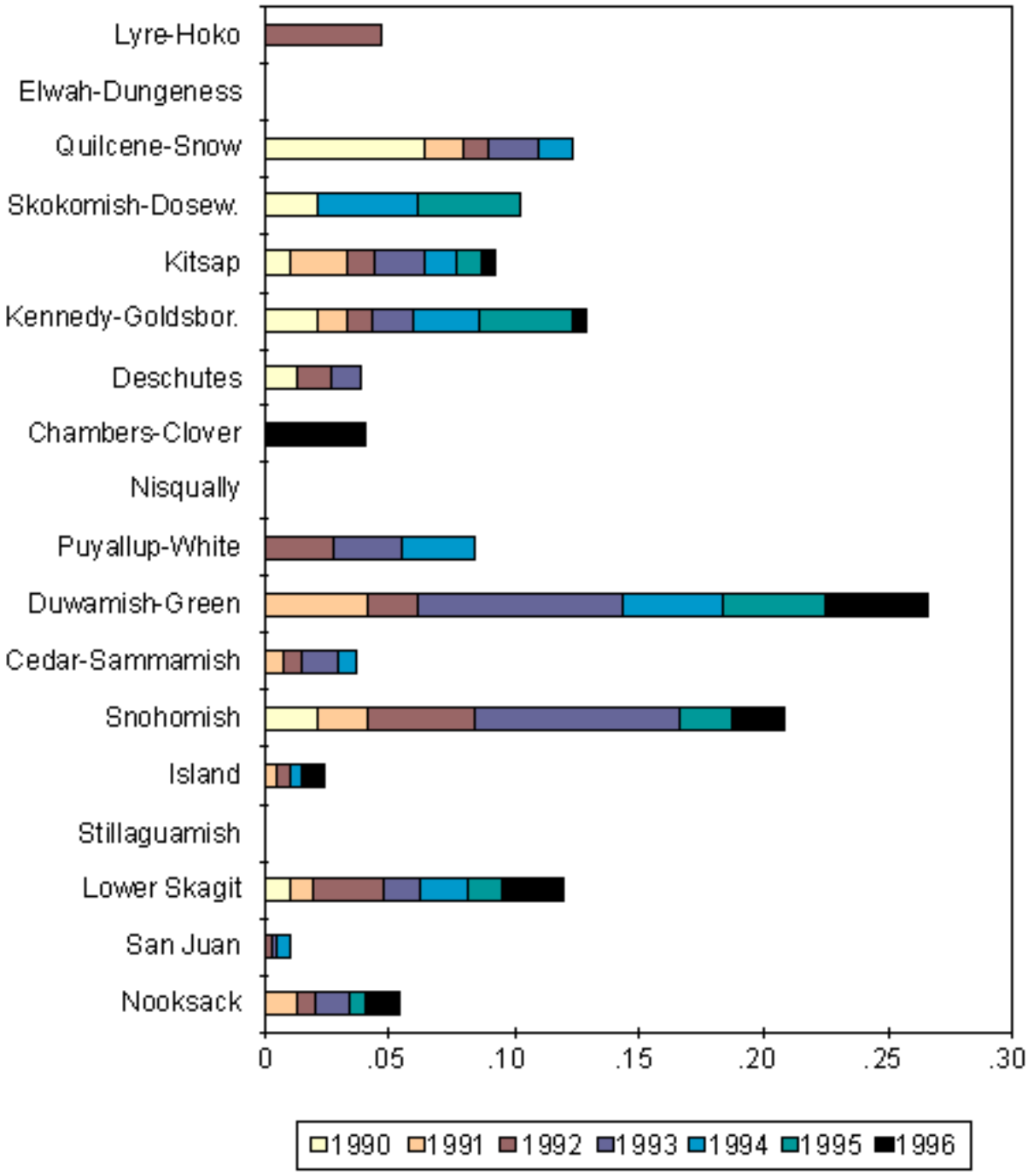

Figure 4. Number of Marine Bank Protection HPA Permits per mile of shoreline (by WRIA) for each year from 1990 to 1996.

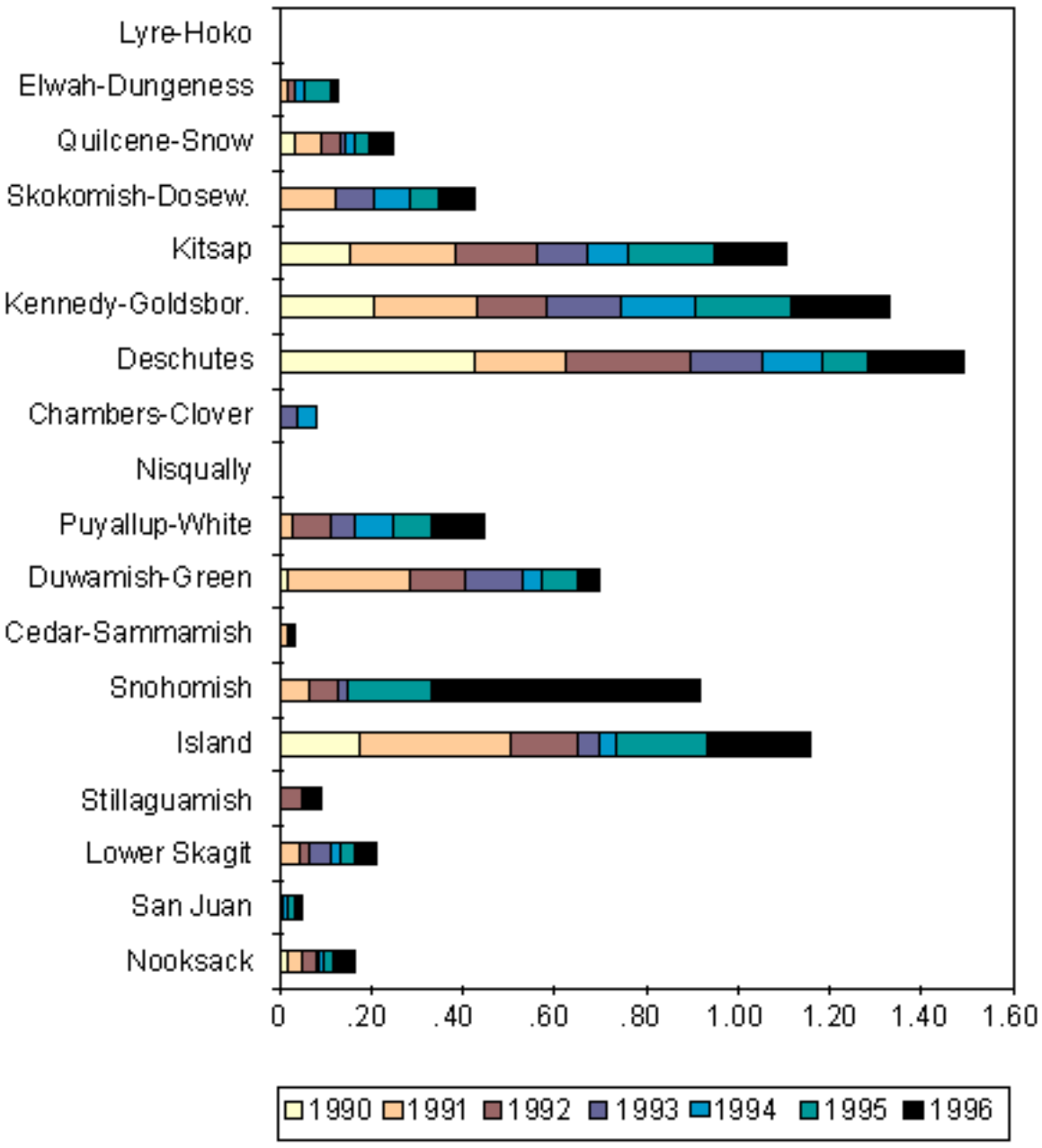

Figure 5. Number of Marine Bulkhead HPA Permits per mile of shoreline (by WRIA) for each year from 1990 to 1996.

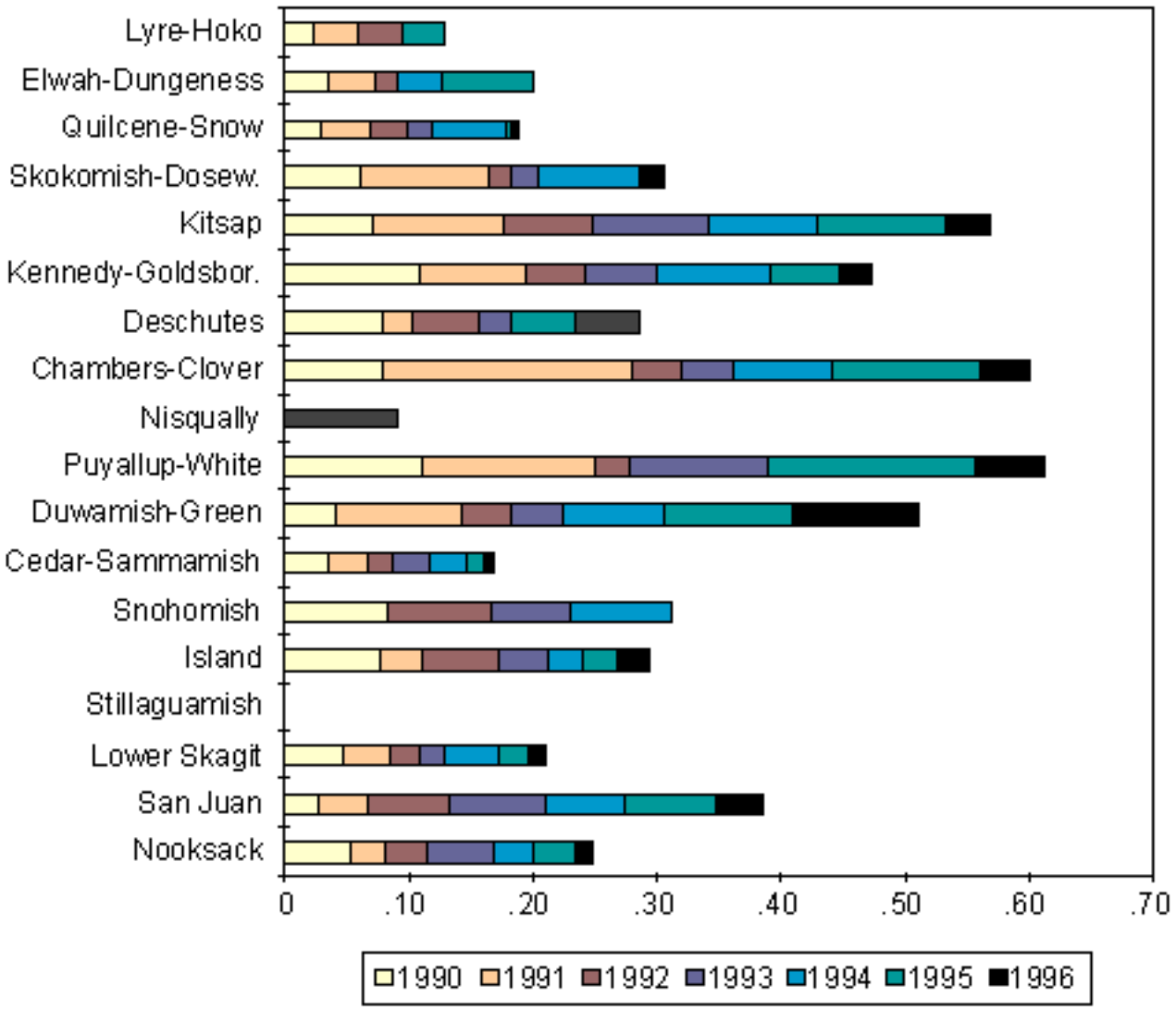

Figure 6. Number of Marine Dock / Pier HPA Permits per mile of shoreline (by WRIA) for each year from 1990 to 1996.

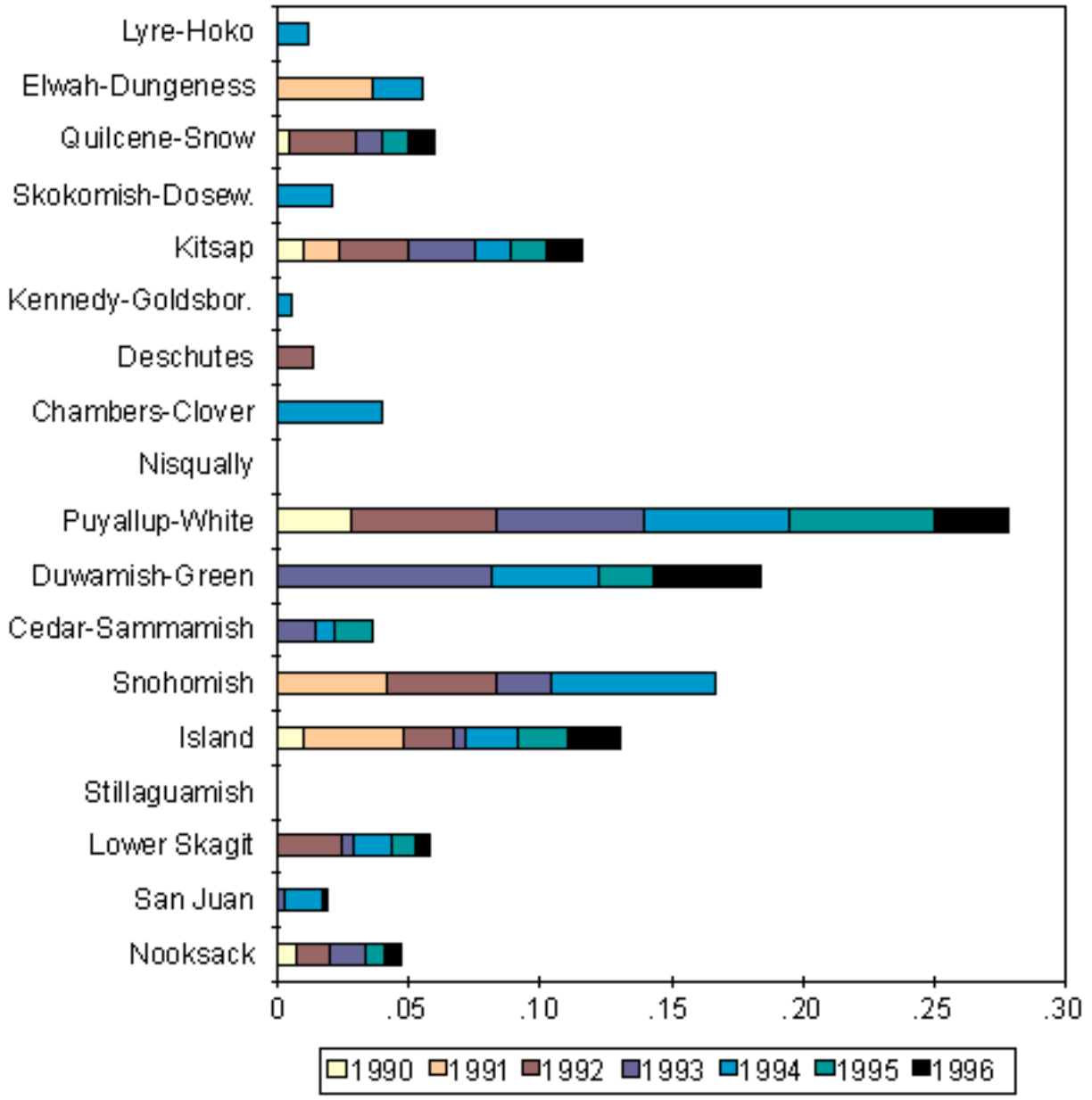

Figure 7. Number of Storm Drain HPA Permits per mile of shoreline (by WRIA) for each year from 1990 to 1996.

Docks and Piers

Local shoreline master programs generally categorize the construction of docks and piers as an exempt activity. Builders are allowed to construct docks and piers as a feature of single family homes. Some shoreline programs specify how docks and piers should be constructed, requiring design criteria such as allowing light to penetrate through the structure or prohibiting the use of creosote pilings. The construction of docks is naturally limited in many areas by exposure to wind and waves, limited access to the beach, low water depths and mudflats. In those protected waterbodies where many docks exist and are considered desirable, regulators worry that too many docks may interfere with the migration of fish and shade eelgrass. Many regulators want better information about cumulative effects of docks and piers on the nearshore environment. Most jurisdictions encourage joint use of docks and piers in order to minimize the number of overwater structures. Regulators admit, however, that joint use is difficult to encourage, probably because of difficulties sharing costs and liabilities among neighbors. Docks and piers were mentioned as an issue of concern in Pierce, San Juan and Kitsap counties.

Eelgrass beds in Puget Sound provide critical habitat for a number of marine species, including herring, Dungeness crab and Pacific salmon. A 1995 study of the impact of overwater structures on eelgrass beds found that many structures built over eelgrass beds in Puget Sound negatively impact the density of eelgrass and that the cumulative effects of overwater structures are significant (Fresh et al., 1995). The report summarized concerns for the effects of docks as follows:

"One source of eelgrass loss is the development of Puget Sound shorelines, such as the construction of small (so-called single family residence) overwater piers, floats and docks. Many such structures are built over eelgrass beds, and while individual structures are small, the large number of structures built in some areas, such as the San Juan Islands and Hood Canal, suggests the potential for significant cumulative effects. For instance, 94 docks and floats have been built in the last five years in the San Juan Islands."

Field staff from the Washington Department of Fish and Wildlife (Fish and Wildlife) are trying to better document and understand the effects of overwater structures. They are also working with people who apply for permits to minimize the effects of docks and piers. In most cases, using grating to allow greater light penetration helps reduce the shading effects of the structure thereby reducing harmful effects on eelgrass.

Upland Runoff

A few scientists and regulators felt that the greatest threat to the nearshore environment comes not from physical alterations to the shoreline but from upland runoff that degrades water quality. Eutrophication is a documented problem in a few areas where water flushes slowly, including lower Hood Canal and Budd Inlet, and scientists have recently observated eutrophi-cation in other isolated areas around Puget Sound (Thom, 1997; Mumford, 1997). Eutrophic waterbodies have reduced dissolved oxygen due to high

levels of organic nutrients. Impacts include increased growth of sea lettuce (ulva), decreased growth of eelgrass (Zostera spp), in-creased turbidity and other suspected, but undocumented, impacts. In a few locations around Puget Sound, mats of sea lettuce were found growing on and around eelgrass beds, inhibiting the growth of eelgrass (Thom, 1997). Resource managers suspect that nutrients are coming from adjacent shoreline developments and residential farming and forestry practices further upland.

Large Commercial and Industrial Development

Regulators expressed concern about the siting of large structures and developments in the nearshore environment. Effects associated with large development projects vary greatly depending on individual project proposals. The dominant concerns include the inability to adequately protect extremely sensitive areas of the shoreline, the lack of information available to substantiate potential impacts to aquatic and nearshore marine resources, and the inability to adequately mitigate for impacts on resources.

Cherry Point, in Whatcom County, was cited as an example of an extremely significant nearshore area where a large development could tremendously impact marine resources. Cherry Point provides approximately half of the spawning ground for herring in Puget Sound. Regulators have long known of the area's importance, but the local land-use plan does not prevent development proposals. Several people interviewed cited Cherry Point as a situation where a permanent protective measure should be taken to protect the resources and preempt development proposals, rather than continuing to battle over individual permits.

Vegetation Removal

Land clearing occurs with most development projects, but nowhere is it of as much concern as at the water's edge. Clearing vegetation removes a source of shading at the shoreline, decreases the contribution of organic debris into the water and depletes the upland-edge habitat for wildlife species. In areas with steep and eroding bluffs, the native vegetation is usually the best tool for keeping the bluff intact and minimizing erosion.

Some local governments provide guidelines for the removal of vegetation in their shoreline master programs, but most regulators admit it is extremely difficult to enforce. Vegetation that is spared during the construction process is often incrementally removed over time to improve views or expand landscaping structures. Restoring an over-cleared area is difficult unless the landowner is committed to replanting, watering and nurturing new plants.

Failing On-site Sewage Systems

Failing on-site sewage systems contribute fecal bacteria and nutrients to the nearshore environment in areas of Puget Sound. Some jurisdictions have taken strong measures to locate failing systems while other areas are just beginning to address the issue. Several county officials stated that failing septics and their impact on nearshore water quality are a primary concern, more so than physical alterations to the shoreline.

Spartina

Spartina, also known as cordgrass, is an introduced and invasive species, that has been found in many areas of northern Puget Sound. Known infestations of Spartina exist in the San Juan islands, Padilla Bay, Skagit Bay, Port Susan, Possession Sound, Tulalip Bay and Whidbey Island. Its presence threatens to disrupt native saltwater systems because it colonizes quickly and changes the habitat structure of the nearshore. Dense clumps of Spartina interfere with the feeding and resting areas of many species of waterfowl. The density of Spartina can also create a sediment trap that raises the level of a mudflat and destroys clam and oyster beds. Because large infestations of Spartina result in a raised tidal area, they may cause increased flooding in river deltas. The infestations range from a one or two clumps to many acres. In total, there are approximately 600 acres of tideflats infested in Puget Sound.

Efforts are underway to identify infestations and curtail their growth through a variety of removal techniques. Volunteer groups help greatly with this effort. Although Spartina has been in Puget Sound for many years, its invasive ability was apparently dormant. Because it is an aggressive and invasive species, great efforts will be required to manage it, as has happened in Willapa Bay.